UCRL-JC-123997 Abs

KINETICS OF THERMAL IGNITION OF AP/AL/HTPB PROPELLANTS

Jon L. Maienschein, Raul G. Garza,
Albert L. Nichols III, Gary L. Johnson
Lawrence Livermore National Laboratory

The kinetics of thermal ignition of propellants is required to understand the response of propellants to high temperatures. In particular, consideration of accident outcomes involving heated propellant such as in a fire requires knowledge of ignition kinetics.

We will report results of the LLNL One-Dimensional-Time-to-Explosion (ODTX) test for propellants containing 86-90% solids with 66-70% AP, 19-20% Al, and 10-14% binder. In this test, a spherical sample with 12.7 mm diameter is contained in a spherical cavity between two preheated aluminum anvils. The time to explosion is measured as a function of temperature. In addition, some measure of the reaction violence is given by the cavity size in the aluminum anvils. Because the ODTX test is a simple, one-dimensional geometry with well-defined initial and boundary conditions and confinement, the resultant data are readily interpretable by standard kinetic models. Many other thermal tests are not as well controlled or defined, so their results are harder to understand.

Using the ODTX data, we will develop a kinetic model for the thermal ignition of the propellant. This model is directly applicable in computer codes such as CALE, DYNA, and ALE3D, which are used to calculate energetic material response to high temperatures. We will also apply our kinetic model to other available data on similar propellants to check the validity of our model.

*This work was performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under contract No. W-7405-Eng-48.